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Hendren et al.

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(54) **TURNTABLE ASSEMBLY FOR STRETCH WRAPPING MACHINE**

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B65B 11/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B65B 11/045*** (2013.01)

(58) **Field of Classification Search**
CPC B65B 11/045
See application file for complete search history.

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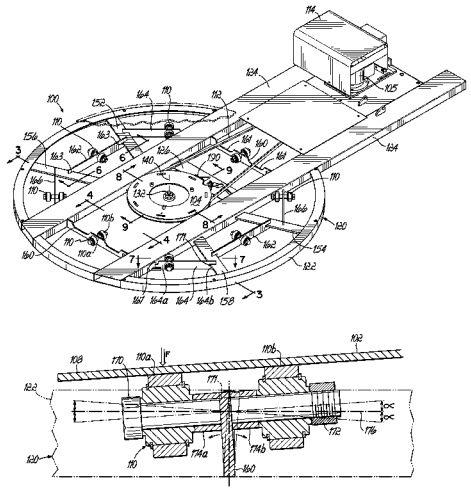
(57) **ABSTRACT**

A turntable assembly for a stretch wrapping machine comprises a frame, a hub rotatably mounted to the frame on a shaft, a turntable mounted to the hub, and a plurality of rollers rotatably mounted to the frame defining a generally horizontal supporting plane for the turntable. Each roller has an axis of rotation generally parallel to the supporting plane and generally passing through the turntable axis of rotation. The frame is constructed so as to elastically deform, upon a load being placed upon the turntable that results in the load not being evenly supported by the rollers, to permit the roller axis of rotation to tilt relative to the horizontal supporting plane while still passing through the turntable axis of rotation.

20 Claims, 6 Drawing Sheets



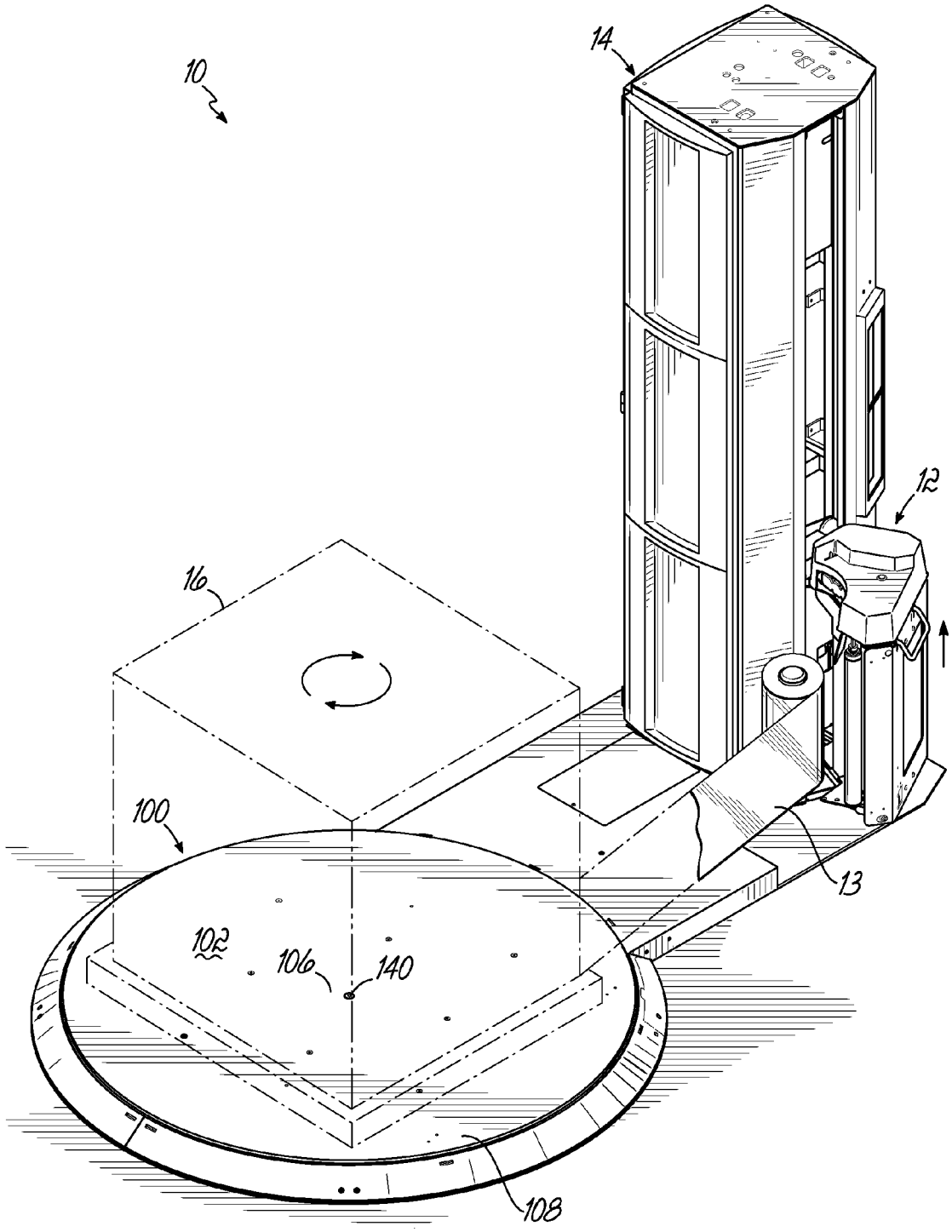


FIG. 1

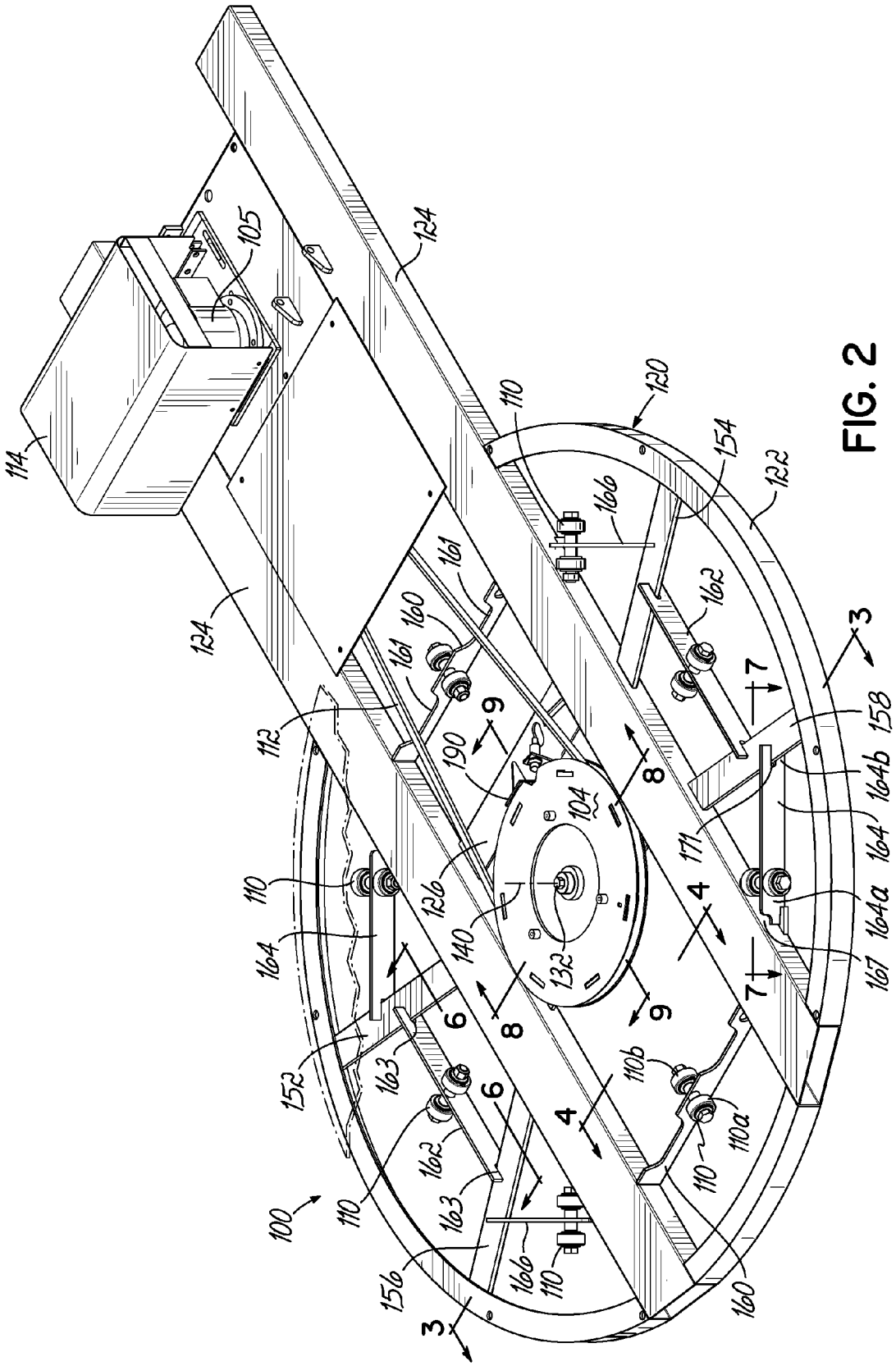

100
105
110
112
114
120
122
124
126
132
140
152
154
156
158
160
161
162
163
164
164a
164b
166
167
171
190
104
110a
110b
3
4
6
7
8
9

FIG. 2

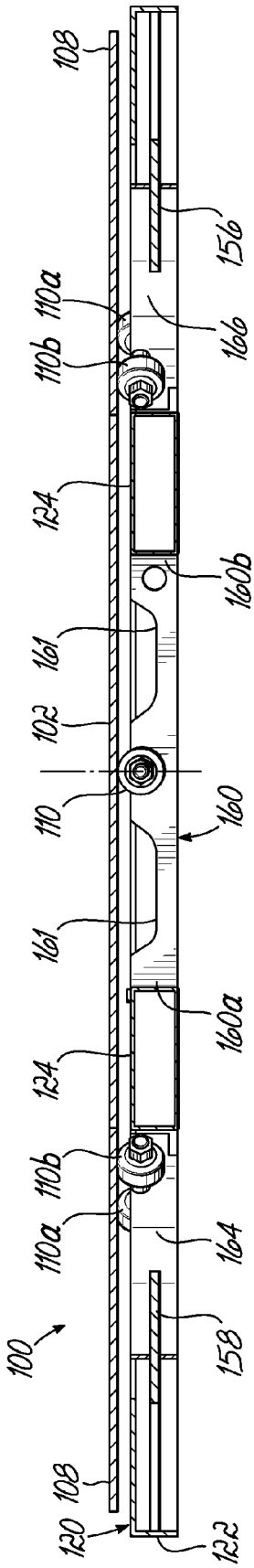

108
156
110a
110b
166
124
160b
161
102
110
160
161
160a
124
110b
110a
164
158
100
108
120
122

FIG. 3

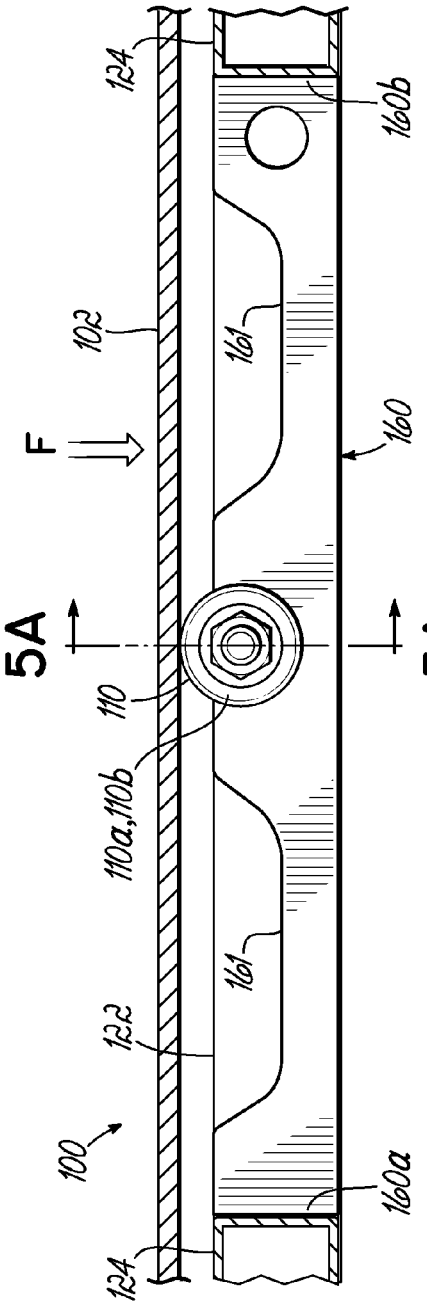

124
160b
102
161
F
160
5A
110
5A
110a,110b
161
122
100
160a
124

FIG. 4

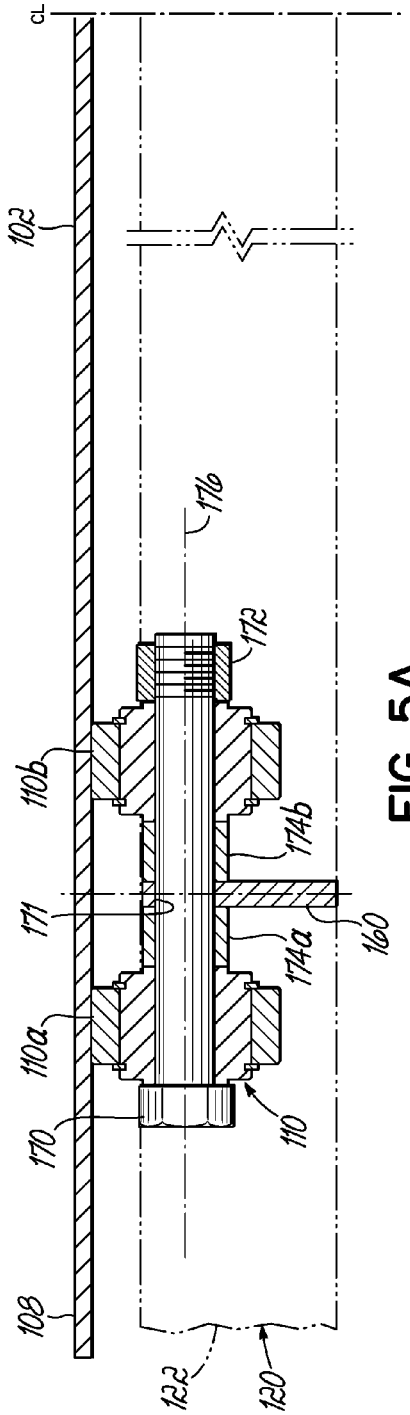

CL
102
176
172
110b
174b
171
160
174a
110a
170
110
108
122
120

FIG. 5A

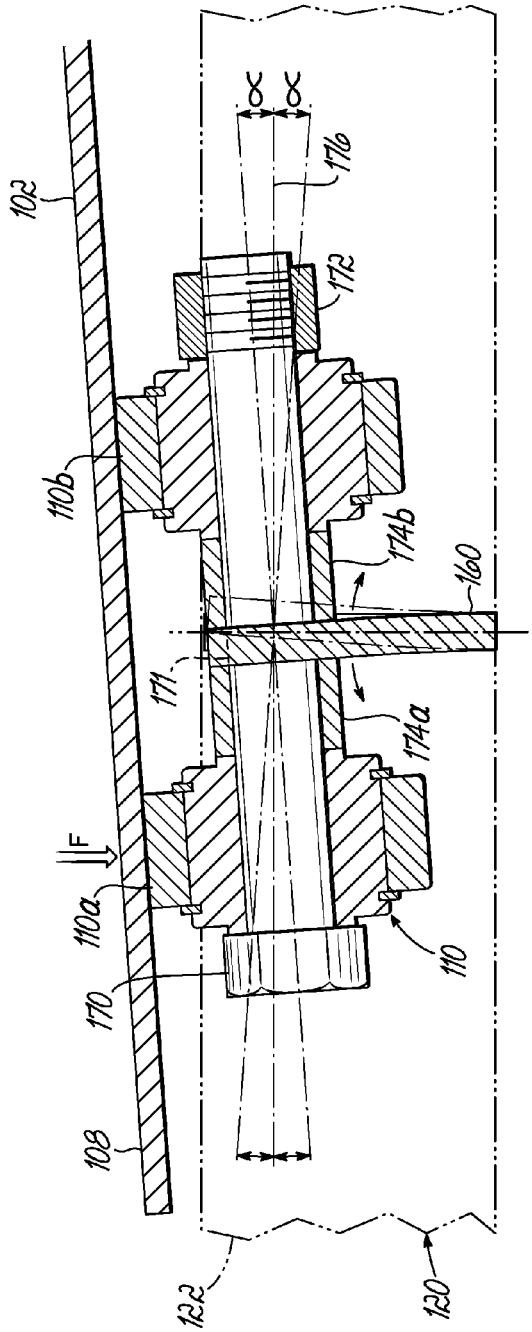

102
176
172
110b
174b
160
171
174a
F
110a
110
170
108
122
120

FIG. 5B

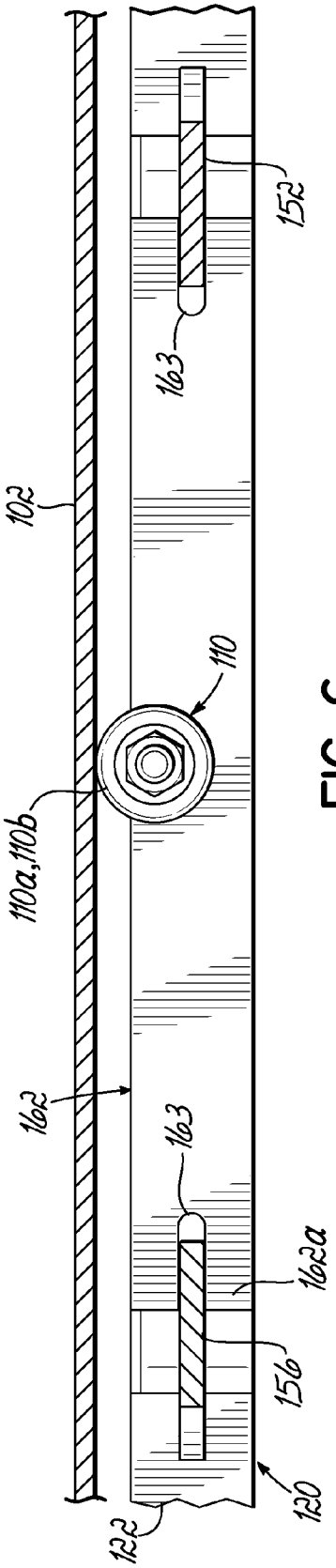

102
152
163
110
110a,110b
162
163
162a
156
120
122

FIG. 6

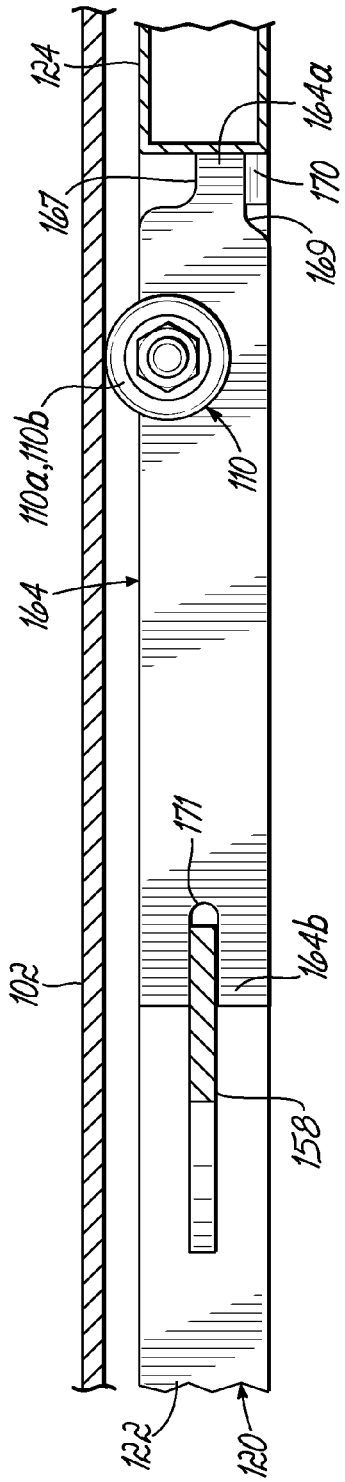

124
164a
167
170
169
110a,110b
110
164
171
102
164b
158
122
120

FIG. 7

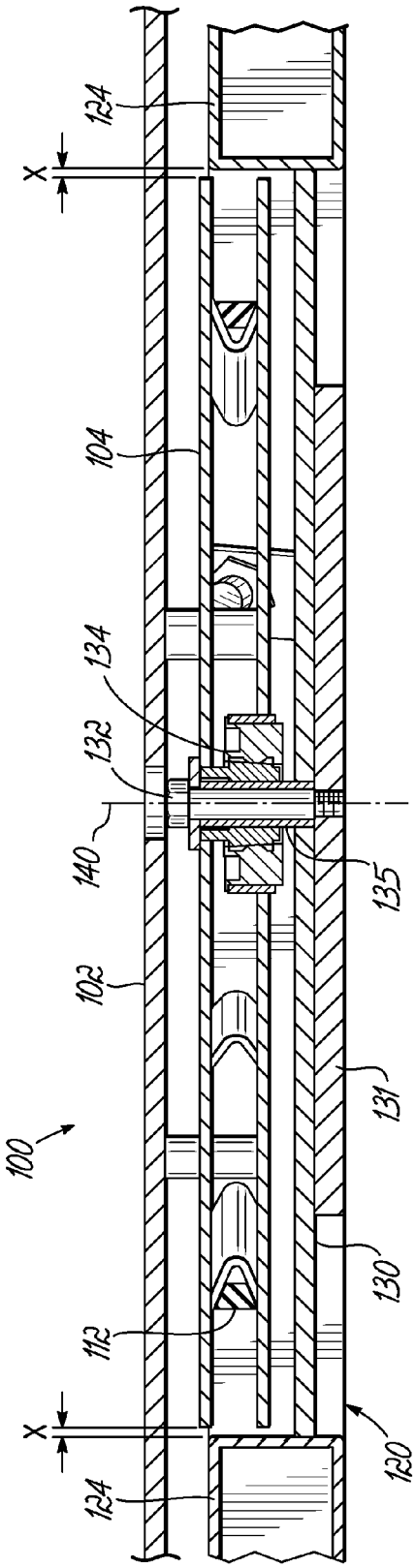

124
X
104
134
132
140
135
102
131
100
130
112
X
120
124

FIG. 8

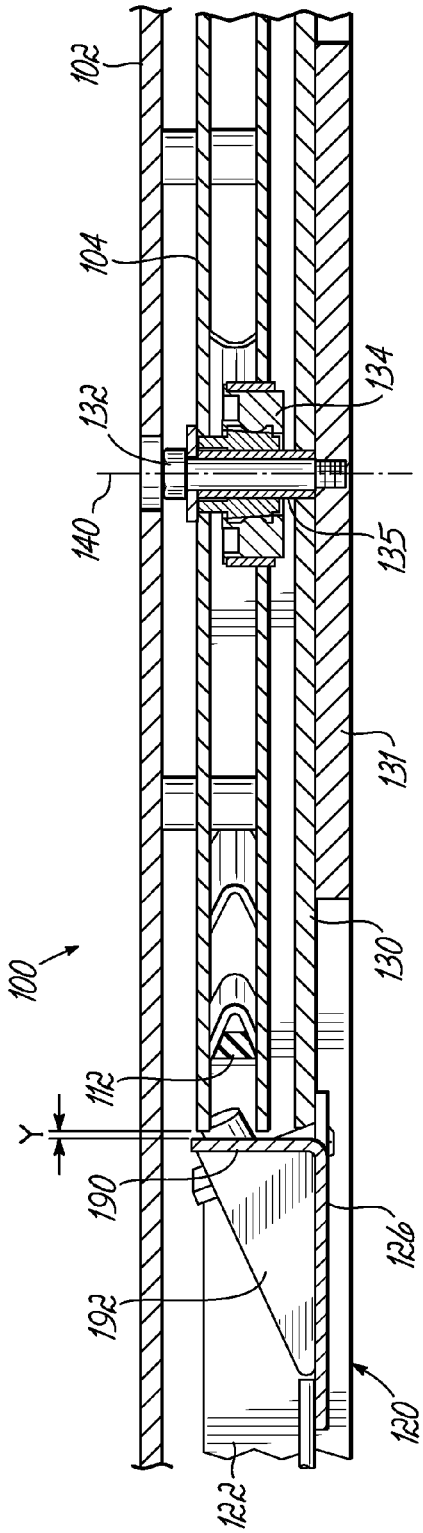

102
104
134
132
140
135
131
130
100
112
Y
190
136
192
120
122

FIG. 9

TURNTABLE ASSEMBLY FOR STRETCH WRAPPING MACHINE

This application claims priority to U.S. Provisional Application Ser. No. 61/644,000 filed May 8, 2012, the disclosure of which is incorporated by reference herein in its entirety.

CROSS-REFERENCE

1. Technical Field

The present disclosure relates to apparatus for wrapping loads with packaging material, and more particularly to apparatus for wrapping plastic film around product on a pallet.

2. Background

Various packaging techniques have been used to assemble a load of unit products and subsequently wrap them for transportation, storage, containment and stabilization, protection and waterproofing. Products are often stacked as a load on a pallet to simplify handling of the products. The pallet load is commonly wrapped with stretch wrap packaging material. One system uses stretch wrapping machines to stretch, dispense, and wrap stretch packaging material around a load. Stretch wrapping can be performed as an inline, automated packaging technique that dispenses and wraps packaging material in a stretched condition around a load on a pallet to cover and contain the load. Pallet stretch wrapping, whether accomplished by a turntable, a rotating arm, or a vertical rotating ring, typically covers the four vertical sides of the load with a stretchable film, such as polyethylene film. In each of these arrangements, relative rotation is provided between the load and the packaging material dispenser to wrap packaging material around the sides of the load.

A turntable type pallet stretch wrapping machine includes a frame, a pulley or hub rotatably mounted to the frame, a turntable mounted on the hub, a vertically movably film dispensing assembly, and a drive mechanism for rotating the hub. The frame includes rollers that rotatably support the underneath surface of the turntable for rotation relative to the film dispensing assembly. A loaded pallet that is to be wrapped with film is placed on the turntable. The loaded pallet is rotated about a generally vertical axis by rotating the turntable with the drive mechanism. The loaded pallet is progressively wrapped circumferentially and vertically, i.e. spirally, by film supplied from a vertically movable roll of film of the film dispensing assembly.

A loaded pallet is typically placed upon the turntable with a forklift or pallet jack. If the loaded pallet is not raised to a sufficient height by the operator of the forklift or pallet jack as the loaded pallet is being positioned over the turntable, the edge of the pallet can strike the edge of the turntable, which can cause plastic deformation, i.e. permanent bending, of the shaft that rotatably mounts the hub to the frame, thus requiring repair. The edge of the turntable can also be struck by other objects or machines encountered in a typical warehouse environment that could cause permanent bending of the shaft. For example, the edge of the turntable could be struck by the tines of a fork truck or pallet jack, the mast of a fork truck, or even by an unpalletized load itself.

Another difficulty associated with placing the loaded pallet upon the turntable is accurately placing the pallet in the center of the turntable. If the loaded pallet is placed on the turntable offset from the rotational axis of the turntable, the weight of the loaded pallet will not be evenly supported by the turntable rollers. Even if the loaded pallet is placed in the center of the turntable, if the load is not evenly distributed on the pallet the same situation can occur. And, even if the loaded pallet is placed in the center of the turntable, and even if the load is evenly distributed on the pallet, the weight of the loaded pallet might still not be evenly supported by the turntable rollers, due to manufacturing tolerances in the production of the frame, turntable, pulley/hub, etc., or due to the effects of the weight distribution of the load in combination with the dynamics of the turntable. All of these scenarios can cause increased wear on the rollers and increased vibration during rotation of the turntable.

Accordingly, a need therefore exists for a stretch wrapping machine turntable assembly that overcomes the drawbacks of conventional stretch wrapping machine turntable assemblies such as those described above.

SUMMARY

The present invention overcomes the foregoing and other shortcomings and drawbacks of conventional turntable assemblies used in stretch wrapping machines. While the invention will be described in connection with certain embodiments, it will be understood that the invention is not limited to these embodiments. On the contrary, the invention includes all alternatives, modifications, and equivalents as may be included within the spirit and scope of the present invention.

According to one aspect of the present invention, a turntable assembly for a stretch wrapping machine comprises a frame, a turntable mounted to the frame for rotation about a generally vertical turntable axis of rotation, and a plurality of rollers rotatably mounted to the frame and defining a generally horizontal supporting plane for supporting the turntable. Each of the plurality of rollers has an axis of rotation generally parallel to the supporting plane and generally passing through the turntable axis of rotation. The frame is constructed of a material and of a geometry so as to elastically deform, upon a load being placed upon the turntable that results in the load not being evenly supported by the rollers, to permit the axis of rotation of at least one roller of the plurality of rollers to tilt relative to the horizontal supporting plane while still passing through the turntable axis of rotation.

The plurality of rollers can comprise a plurality of pairs of rollers, each pair of rollers of the plurality of pairs of rollers being mounted on a respective frame member of the frame such that one roller of the pair of rollers is positioned on one side of the frame member and the other roller of the pair of rollers is positioned on the other side of the frame member. In one embodiment, each frame member can be constructed such that the deflection under load conditions will not exceed the yield strength of the material of the frame member. Each frame member can be constructed of a material and of a geometry so as to elastically deform an amount sufficient to permit the roller pair axis of rotation to tilt about 3 degrees when a load of about 3,500 pounds is placed on one roller of the pair of rollers. For example, each frame member can be generally rectangular in cross section having a height of about 2.0 inches and a width of about 0.25 inches, and can be fabricated of A36 steel. The pair of rollers can be positioned generally midway along a length of the frame member. The frame member can have a reduced height between the pair of rollers and each end of the frame member if desired. Alternatively the pair of rollers can be positioned near one end of the frame member, and the frame member can have a reduced height at the end near which the pair of rollers is positioned.

In another aspect of the present invention, a turntable assembly for a stretch wrapping machine comprises a frame, a hub rotatably mounted to the frame on a shaft, and a turntable mounted to the hub for rotation about a generally vertical turntable axis of rotation. The frame includes hub deflec-

tion limiting structure spaced around the turntable axis of rotation at about 0 degrees, at about 90 degrees, and at about 180 degrees. The deflection limiting structure is spaced from the hub by an amount such that if the turntable is struck causing the hub to bend the shaft, the shaft will elastically deform rather than plastically deform.

The frame of the turntable assembly can comprise a generally circular outer frame member, a pair of generally longitudinally oriented frame members connected to the outer frame member, one of the pair of longitudinally oriented frame members being located on one side of the hub and the other of the pair of longitudinally oriented frame members being located on the other side of the hub, and a generally transversely oriented frame member connected to the pair of generally longitudinally oriented frame members. For example, each of the pair of generally longitudinally oriented frame members can be spaced from an outer edge of the hub by about 3/32 inches, and the generally transversely oriented frame member can be spaced from an outer edge of the hub by about 3/32 inches.

The above and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the general description of the invention given above, and the detailed description given below, serve to explain the principles of the invention.

FIG. **1** is a perspective view of an exemplary apparatus for wrapping a load, including an exemplary turntable assembly in accordance with the principles of the present disclosure.

FIG. **2** is an enlarged perspective view of the turntable assembly of FIG. **1**, with the turntable removed.

FIG. **3** is a view taken along line **3**-**3** in FIG. **2**.

FIG. **4** is a view taken along line **4**-**4** in FIG. **2**.

FIG. **5**A is a view taken along line **5**A-**5**A in FIG. **4**.

FIG. **5**B is a view similar to FIG. **5**A but in the deflected position.

FIG. **6** is a view taken along line **6**-**6** in FIG. **2**.

FIG. **7** is a view taken along line **7**-**7** in FIG. **2**.

FIG. **8** is a view taken along line **8**-**8** in FIG. **2**.

FIG. **9** is a view taken along line **9**-**9** in FIG. **2**.

DETAILED DESCRIPTION

Reference will now be made to the present embodiments of the disclosure, examples of which are illustrated in the accompanying figures. Wherever possible, the same reference numbers will be used throughout the figures to refer to the same or like parts.

As shown in FIG. **1**, a wrapping apparatus **10** includes a packaging material dispenser **12** configured to dispense packaging material **13** onto a load **16**. Packaging material dispenser **12** may be configured to travel substantially vertically up and down a support column **14** while dispensing the packaging material **13**. The vertical movement of packaging material dispenser **12** and the relative rotation between load **16** and packaging material dispenser **12** provides for wrapping of load **16** with the packaging material **13** in a spiral fashion, as would be apparent to one skilled in the art.

Relative rotation between packaging material dispenser **12** and load **16** may be provided by a turntable assembly **100**, shown in FIGS. **1** and **2**. Turntable assembly **100** may include a turntable **102** upon which load **16** rests. In FIG. **2**, turntable **102** has been removed to expose turntable assembly components underneath. As shown in FIG. **2**, turntable assembly **100** includes a pulley or hub **104**. A central portion **106** of turntable **102** may be coupled to pulley **104** such that turntable **102** may rotate as pulley **104** rotates. An outer portion **108** of turntable **102** engages rollers **110**. Rollers **110** are configured to rotatably support outer portion **108** of turntable **102** and define a generally horizontal supporting plane for turntable **102**.

A belt **112** operatively couples pulley **104** and a drive mechanism **114**. Belt **112** is in tension, and engages portions of pulley **104** and drive mechanism **114**. The drive mechanism **114** may include, for example, a motor **105** configured to engage and drive belt **112**. Belt **112**, pulley **104**, and the drive mechanism **114** may form a drive assembly. When belt **112** is driven, belt **112** causes rotation of pulley **104**, turntable **102**, and load **16**. Drive elements other than belts and pulleys may be used.

Referring to FIGS. **2**, **8**, and **9**, turntable assembly **100** further includes a frame **120** including a generally circular outer frame member or beam **122**, a pair of generally longitudinally oriented frame members or beams **124**, **124** connected to the outer frame member **122**, and a generally transversely oriented frame member or beam **126** connected to the pair of generally longitudinally oriented frame members **124**, **124**. Frame **120** further includes a base plate **130** connected to the pair of generally longitudinally oriented frame members **124**, **124**. Pulley or hub **104** is rotatably mounted to base plate **130** via a shaft, for example bolt **132** threaded into backer bar **131** below base plate **130**, a bearing **134**, and a spacer **135**, for rotation about a generally vertical turntable axis of rotation **140**. While a bolt with spacer is illustrated as being used to rotatably mount pulley **104** to base plate **130**, other elements such as a shaft, a pin, an axle, a rod, and the like could be used. Accordingly, the term "shaft" as used herein shall be deemed to generically embrace bolts, spacers, shafts, pins, axles, rods, and the like. Frame **120** further includes cross frame members or cross straps **152**, **154**, **156**, **158** interconnecting outer frame member **122** and the pair of generally longitudinally oriented frame members **124**, **124**. The various frame members of frame **120** can be fabricated of, for example, steel, and can be connected where indicated as by welding or the like.

Referring to FIGS. **2**-**7**, it will be seen that frame **120** further includes a number of additional frame members or beams or plates mounting rollers **110** to frame **120**. More particularly, a first pair of frame members or beams **160**, **160** are connected between the pair of generally longitudinally oriented frame members **124**, **124** at approximately the 12 o'clock and 6 o'clock positions relative to the circular outer frame member **122** (the 12 o'clock position being nearest the dispenser **12** and column **14**). A second pair of frame members or beams **162**, **162** are connected between straps **152**, **156** and **154**, **158**, respectively at approximately the 3 o'clock and 9 o'clock positions relative to the circular outer frame member **122**. A third pair of frame members or beams **164**, **164** are connected between strap **152** and one of the generally longitudinally oriented frame members **124**, and between strap **158** and the other of the generally longitudinally oriented frame members **124**, respectively, at approximately the 10:30 o'clock and 4:30 o'clock positions relative to the circular outer frame member **122**. A fourth pair of frame members or beams **166**, **166** are connected between strap **154** and one of the generally longitudinally oriented frame members **124**, and between strap **156** and the other of the generally longitudinally oriented frame members **124**, respectively, at approximately the 1:30 o'clock and 7:30 o'clock positions relative to the circular outer frame member **122**. The frame

members of frame member pair **160**, **160** are substantially identical to one another. Similarly, the frame members of frame member pair **162**, **162** are substantially identical to one another. Similarly, the frame members of frame member pairs **164**, **164** and **166**, **166** are all substantially identical to one another; however, the frame members of frame member pair **164**, **164** are flipped end-to-end relative to one another as assembled, as are the frame members of frame member pair **166**, **166**.

The first, second, third, and fourth pairs of frame members **160**, **160**; **162**, **162**; **164**, **164**; and **166**, **166** support the rollers **110**. Each roller **110** preferably includes first and second rollers such as roller bearings **110***a*, **110***b* located on opposite sides of a respective frame member and spaced from each other (centerline-to-centerline) by about 2.76 inches. Referring to FIG. **5**A, it will be seen that rollers **110***a*, **110***b* are secured to frame member **160** via bolt **170** passing through roller **110***a*, spacer **174***a*, hole **171** in frame member **160**, spacer **174***b*, and roller **110***b*, and secured with nut **172**, for rotation about an axis **176**. Rollers **110***a*, **110***b* are secured to frame members **162**, **164**, and **166** in a similar fashion. To accommodate for uneven loading of the rollers **110***a*, **110***b*, for example when a force F is centered over one of the rollers **110***a*, **110***b* as is shown in FIG. **5**B rather than equally between them, the material and geometry of the roller supporting frame members or beams are selected so as to provide a degree of flexibility of the frame members. This permits the frame member or beam to elastically deform to permit the axis of rotation **176** of the rollers **110***a*, **110***b* to tilt by an angle α relative to the horizontal supporting plane to maintain contact of rollers **110***a*, **110***b* with the underneath side of the turntable **102**, thus maintaining substantially even load distribution between the two rollers. Advantageously, when the frame member deflects thus tilting axis **176** of the rollers **110***a*, **110***b*, the axis **176** nevertheless continues to still substantially pass through the turntable axis of rotation **140**, thereby avoiding the undesirable "toe-in/toe-out" effect that some prior attempts at solving the uneven load distribution problem suffer from. Toe-in/toe-out is undesirable in that it creates additional friction/heat, wear on the rollers, wear on the motor, etc., as the turntable **102** is rotated with drive mechanism **114**. The above-described assembly avoids toe-in/toe-out due to the bolt connection of the rollers **110***a*, **110***b* to its respective frame member via bolt **170**, spacers **174***a*, **174***b*, and nut **176**, torqued sufficiently to impart sufficient preload on the bolted joint.

As mentioned above, the desired stiffness or spring rate of the roller supporting frame members or beams can be obtained through the selection of a number of variables, such as the material of the frame members, the cross-section of the frame members, the length of the frame members, the position of the rollers along the frame members, the "end conditions" of the frame members, i.e. how the ends of the frame members are attached to adjacent structure (welding generally makes for a stiffer connection and hence a stiffer frame member, whereas bolting/screwing generally makes for a less stiff connection and hence a less stiff frame member, whereas pinning/riveting generally makes for an even less stiff connection and hence an even less stiff frame member, for example), and the like. One example of such a combination of variables that produces an acceptable stiffness or spring rate is to fabricate the frame members or beams from A36 steel with a rectangular cross-section having a height of about 2 inches and a width of about 0.25 inches, in combination with the following lengths and end conditions of the frame members or beams.

Referring to FIG. **4**, for frame members **160**, **160** the rollers **110***a*, **110***b* are positioned generally midway along a length of the frame member. Frame members **160**, **160** can include reduced height areas **161**, **161** between the pair of rollers **110***a*, **110***b* and each end of frame member **160**. Each end **160***a*, **160***b* of each frame member **160** is welded to one of the pair of generally longitudinally oriented frame members **124**. While these reduced height areas **161**, **161** are to provide clearance for belt **112** (FIG. **2**), they can also be utilized to reduce the stiffness or spring rate of the frame member to produce the desired stiffness or spring rate. Frame members **160** are about 18.3 inches long.

Referring to FIG. **6**, for frame members **162**, **162** the rollers **110***a*, **110***b* are also positioned generally midway along a length of the frame member. Each end **162***a*, **162***b* of each frame member **162** is slotted as at **163** to accommodate a respective one of the cross straps **152**, **156** or **154**, **158**, and is welded thereto. Frame members **162** are about 17.75 inches long.

Referring to FIG. **7**, for frame members **164**, **164** and **166**, **166** the rollers **110***a*, **110***b* are positioned near one end of the frame member, due to the desire to equally space the rollers around the frame **120** and due to geometric constraints imposed by the various other frame members of the frame **120**. Since locating the rollers **110***a*, **110***b* near one end of the frame member makes for a higher stiffness or spring rate, a reduced height area for frame member **164** and **166** is desirable to reduce the stiffness or spring rate to generally match that of the other frame members **160**, **162**. To that end, a reduced height area **167** is included on an upper side and at that end **164***a* of the frame member **164**, i.e. between the rollers **110***a*, **110***b* and the connection to adjacent structure, which in this case is one of the pair of generally longitudinally oriented frame members **124**. End **164***a* includes a further reduced height area on a lower side thereof in the form of a notch **169** that is supported on a tang **170** that is welded to the generally longitudinally oriented frame member **124**. End **164***a* is welded to tang **170** and to frame member **124**. The other end **164***b* of frame member **164** is slotted as at **171** to accommodate a respective one of the cross straps **152**, **154**, **156**, **158**, and is welded thereto. Frame members **164** and **166** are about 13 inches long.

The above-described roller supporting frame member materials, frame member cross-sectional shapes and dimensions, frame member lengths, positions of the rollers along the lengths of the frame members, and frame member end conditions are merely illustrative and exemplary; other materials, shapes, dimensions, lengths, roller positions, and end conditions can also be used to produce acceptable stiffnesses/spring rates. It is believed that the above-described materials, shapes, dimensions, lengths, roller positions, and end conditions produce about a 3 degree angle of tilt a if a 3,500 pound point load is placed at the centerline of one of the rollers **110***a*, **110***b*, as shown in FIG. **5**B, as predicted via numerical simulation, i.e. via finite element analysis. Other stiffnesses/spring rates can be used; the 1166.67 pounds per degree stiffness/spring rate is merely illustrative and exemplary.

As mentioned above, frame **122** of turntable assembly **120** includes a pair of generally longitudinally oriented frame members or beams **124**, **124** connected to the outer frame member **122**, and a generally transversely oriented frame member or beam **126** connected to the pair of generally longitudinally oriented frame members **124**, **124**. Hub or pulley **104** is rotatably mounted to base plate **130** of frame **122** via shaft **132**. As shown in FIGS. **8** and **9**, generally longitudinally oriented frame members or beams **124**, **124** and generally transversely oriented frame member or beam **126** func-

tion as hub deflection limiting structure spaced around the turntable axis of rotation (as viewed in FIG. **2**) at about 0 degrees (3 o'clock position in illustrated embodiment), at about 90 degrees (12 o'clock position in illustrated embodiment), and at about 180 degrees (9 o'clock position as illustrated). The generally longitudinally oriented frame members or beams **124**, **124** are each spaced from an outer edge of the hub or pulley **104** by a distance X of about 3/32 inches. This distance is such that if the turntable is struck with a pallet or other structure at either the 3 o'clock position or at the 9 o'clock position causing the hub **104** to bend the shaft **132** and/or spacer **135**, the shaft **132** and/or spacer **135** will only elastically deform rather than plastically deform. Similarly, and as shown in FIG. **9**, the generally transversely oriented frame member or beam **126** is spaced from an outer edge of the hub or pulley **104** by a distance Y of about 3/32 inches, likewise a distance such that if the turntable is struck with a pallet or other structure at the 6 o'clock location causing the hub **104** to bend the shaft **132** and/or spacer **135**, the shaft **132** and/or spacer **135** will only elastically deform rather than plastically deform. Note that a pallet generally cannot be loaded from the 12 o'clock position with a forklift or pallet jack due to interference from the dispensing assembly **12** and tower 14, and so hub deflection limiting structure is generally not necessary at the 6 o'clock position. Since generally transversely oriented frame member **126** is generally located below the pulley or hub **104** (unlike frame members **124**, **124** which are generally aligned with pulley or hub **104**), the frame member **126** can include an upturned portion **190** braced by gusset **192** to perform the hub deflection limiting function.

The above distances X and Y are a function of, among other things, the yield strength of the material from which the shaft **132** and/or spacer **135** are fabricated. For example, bolt **132** was chosen to be an M12 class 10.9 hex head bolt, and spacer **135** was chosen to be a length of 1018 cold-rolled hex head rod, the lower end of which is non-rotatably mounted in a mating hex hole in base plate **130**. In addition, base plate **130** was chosen to be fabricated of A36 steel having a length of about 18 inches, a width of about 8 inches, and a thickness of about 0.25 inches, and backer bar **131** was chosen to be fabricated of A36 steel having a length of about 12 inches, a width of about 2 inches, and a thickness of about 0.5 inches. These materials, shapes, sizes, etc., and distances X and Y, are merely illustrative and exemplary; other materials, shapes, sizes, etc., and distances X and Y can also be used to produce acceptable results.

While the present invention has been illustrated by the description of one or more embodiments thereof, and while the embodiments have been described in considerable detail, they are not intended to restrict or in any way limit the scope of the appended claims to such detail. For example, while roller pairs have been shown and described, the invention could as well be practiced with single rollers cantilevered from their supporting structure. The various features shown and discussed herein may be used alone or in combination. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the scope or spirit of Applicants' general inventive concept.

What is claimed is:

1. A turntable assembly for a stretch wrapping machine, said turntable assembly comprising:

a frame,

a turntable mounted to said frame for rotation about a generally vertical turntable axis of rotation, and

a plurality of rollers rotatably mounted to said frame and defining a generally horizontal supporting plane for supporting said turntable, each of said plurality of rollers having an axis of rotation generally parallel to the supporting plane and generally passing through the turntable axis of rotation,

said frame constructed of a material and of a geometry so as to elastically deform, upon a load being placed upon said turntable that results in the load not being evenly supported by said rollers, to permit the axis of rotation of at least one roller of said plurality of rollers to tilt relative to the horizontal supporting plane while still passing through the turntable axis of rotation,

said frame including a generally flat frame member having a generally rectangular cross-section extending in a generally vertical direction with a hole formed therein through a thinnest width of the generally rectangular cross-section and extending along an axis generally parallel to the horizontal supporting plane, said at least one roller being rigidly mounted to said frame member through said hole with said axis of rotation in a generally parallel relationship with the axis of the hole, wherein said frame member is constructed of a material and of a geometry so as to elastically deform in response to a force applied to said at least one roller by the load while maintaining the generally parallel relationship with the axis of the hole to which said at least one roller is rigidly mounted.

2. The turntable assembly of claim **1** wherein said plurality of rollers comprises a plurality of pairs of rollers, each pair of rollers of said plurality of pairs of rollers being mounted on a respective frame member of said frame such that one roller of said pair of rollers is positioned on one side of said frame member and the other roller of said pair of rollers is positioned on the other side of said frame member.

3. The turntable assembly of claim **2** wherein each said frame member is constructed of a material and of a geometry such that the frame member will deflect without exceeding yield strength of the material when a load of about 3,500 pounds is placed on one roller of said pair of rollers.

4. The turntable assembly of claim **2** wherein each said frame member is constructed of a material and of a geometry so as to elastically deform an amount sufficient to permit the roller pair axis of rotation to tilt about 3 degrees when a load of about 3,500 pounds is placed on one roller of said pair of rollers.

5. The turntable assembly of claim **4** wherein each said frame member is generally rectangular in cross section having a height of about 2.0 inches and a width of about 0.25 inches, and is fabricated of A36 steel.

6. The turntable assembly of claim **2** wherein a first pair of rollers among said plurality of pairs of rollers is positioned generally midway along a length of said respective frame member.

7. The turntable assembly of claim **6** wherein said respective frame member of said first pair of rollers has a reduced height between said first pair of rollers and each end of said respective frame member.

8. The turntable assembly of claim **2** wherein a first pair of rollers among said plurality of pairs of rollers is positioned near one end of said respective frame member, said respective

frame member of said first pair of rollers having a reduced height at the end near which said first pair of rollers is positioned to reduce a stiffness of said frame member proximate the end near which said pair of rollers is positioned to generally match that of another respective frame member of said frame.

9. The turntable assembly of claim **1**, wherein said plurality of rollers includes a first pair of rollers, said first pair of rollers being mounted on said frame member such that one roller of said first pair of rollers is positioned on one side of said frame member and the other roller of said first pair of rollers is positioned on the other side of said frame member, said first pair of rollers mounted to said frame member through a bolt extending through said hole and through which the axis of rotation projects, said turntable assembly further comprising a nut securing said first pair of rollers to said frame member and torqued to impart a preload to a joint between said first pair of rollers and said frame member.

10. A turntable assembly for a stretch wrapping machine, said turntable assembly comprising:

a frame,

a hub rotatably mounted to said frame on a shaft, and

a turntable mounted to said hub for rotation about a generally vertical turntable axis of rotation,

said frame including hub deflection limiting structure spaced around the turntable axis of rotation at about 0 degrees, at about 90 degrees, and at about 180 degrees, said deflection limiting structure spaced from said hub by an amount such that if said turntable is struck in a direction generally transverse to the turntable axis of rotation causing said hub to bend said shaft, said shaft will elastically deform rather than plastically deform, a portion of said hub deflection limiting structure disposed at about 90 degrees around the turntable axis of rotation and spaced from said hub an amount such that said hub will contact the portion of said hub deflection limiting structure prior to plastic deformation of said shaft.

11. The turntable assembly of claim **10** wherein said frame further comprises:

a generally circular outer frame member,

a pair of generally longitudinally oriented frame members connected to said outer frame member, one of said pair of longitudinally oriented frame members being located on one side of said hub and the other of said pair of longitudinally oriented frame members being located on the other side of said hub, and

a generally transversely oriented frame member connected to said pair of generally longitudinally oriented frame members, wherein the portion of said hub deflection limiting structure is disposed on said generally transversely oriented frame member,

each of said pair of generally longitudinally oriented frame members spaced from an outer edge of said hub by about 3/32 inches,

said generally transversely oriented frame member spaced from an outer edge of said hub by about 3/32 inches.

12. A turntable assembly for a stretch wrapping machine, said turntable assembly comprising:

a frame,

a hub rotatably mounted to said frame on a shaft,

a turntable mounted to said hub for rotation about a generally vertical turntable axis of rotation, and

a plurality of rollers rotatably mounted to said frame and defining a generally horizontal supporting plane for supporting said turntable, each of said plurality of rollers having an axis of rotation generally parallel to the supporting plane and generally passing through the turntable axis of rotation,

said frame constructed of a material and of a geometry so as to elastically deform, upon a load being placed upon said turntable that results in the load not being evenly supported by said rollers, to permit the axis of rotation of at least one roller of said plurality of rollers to tilt relative to the horizontal supporting plane while still passing through the turntable axis of rotation,

said frame including a generally flat frame member having a generally rectangular cross-section extending in a generally vertical direction with a hole formed therein through a thinnest width of the generally rectangular cross-section and extending along an axis generally parallel to the horizontal supporting plane, said at least one roller being rigidly mounted to said frame member through said hole with said axis of rotation in a generally parallel relationship with the axis of the hole, wherein said frame member is constructed of a material and of a geometry so as to elastically deform in response to a force applied to said at least one roller by the load while maintaining the generally parallel relationship with the axis of the hole to which said at least one roller is rigidly mounted,

said frame including hub deflection limiting structure spaced around the turntable vertical axis of rotation at about 0 degrees, at about 90 degrees, and at about 180 degrees, said deflection limiting structure spaced from said hub by an amount such that if said turntable is struck in a direction generally transverse to the turntable vertical axis of rotation causing said hub to bend said shaft, said shaft will elastically deform rather than plastically deform.

13. The turntable assembly of claim **12** wherein said plurality of rollers comprises a plurality of pairs of rollers, each pair of rollers of said plurality of pairs of rollers being mounted on a respective frame member of said frame such that one roller of said pair of rollers is positioned on one side of said frame member and the other roller of said pair of rollers is positioned on the other side of said frame member.

14. The turntable assembly of claim **13** wherein each said frame member is constructed of a material and of a geometry so as to elastically deform an amount sufficient to permit the roller pair axis of rotation to tilt about 3 degrees when a load of about 3,500 pounds is placed on one roller of said pair of rollers.

15. The turntable assembly of claim **14** wherein each said frame member is generally rectangular in cross section having a height of about 0.25 inches and a width of about 2.0 inches, and is fabricated of A36 steel.

16. The turntable assembly of claim **13** wherein a first pair of rollers among said plurality of pairs of rollers is positioned generally midway along a length of said respective frame member.

17. The turntable assembly of claim **16** wherein said respective frame member of said first pair of rollers has a reduced height between said first pair of rollers and each end of said respective frame member.

18. The turntable assembly of claim **13** wherein a first pair of rollers among said plurality of pairs of rollers is positioned near one end of said respective frame member, said respective frame member of said first pair of rollers having a reduced height at the end near which said first pair of rollers is positioned to reduce a stiffness of said frame member proximate

the end near which said pair of rollers is positioned to generally match that of another respective frame member of said frame.

19. The turntable assembly of claim **12** wherein said frame further comprises:

a generally circular outer frame member,

a pair of generally longitudinally oriented frame members connected to said outer frame member, one of said pair of longitudinally oriented frame members being located on one side of said hub and the other of said pair of longitudinally oriented frame members being located on the other side of said hub, and

a generally transversely oriented frame member connected to said pair of generally longitudinally oriented frame members, wherein a portion of said generally transversely oriented frame member is spaced from said hub an amount such that said hub will contact the portion of said hub deflection limiting structure prior to plastic deformation of said shaft,

each of said pair of generally longitudinally oriented frame members spaced from an outer edge of said hub by about 3⁄32 inches,

said generally transversely oriented frame member spaced from an outer edge of said hub by about 3⁄32 inches.

20. The turntable assembly of claim **12**, wherein said plurality of rollers includes a first pair of rollers, said first pair of rollers being mounted on said frame member such that one roller of said first pair of rollers is positioned on one side of said frame member and the other roller of said first pair of rollers is positioned on the other side of said frame member, said first pair of rollers mounted to said frame member through a bolt extending through said hole and through which the axis of rotation projects, said turntable assembly further comprising a nut securing said first pair of rollers to said frame member and torqued to impart a preload to a joint between said first pair of rollers and said frame member.

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